

ANNUAL RESEARCH PROGRESS REPORT
Report of Progress (AD-421)

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Title: FOREIGN EXPLORATION FOR BIOLOGICAL CONTROL AGENTS OF
MELALEUCA & OTHER EXOTIC PLANT PESTS OF THE US

1. What major problem or issue is being resolved and how are you resolving it?

Melaleuca quinquenervia, the Australian broad-leaved paperbark tree, and *Lygodium microphyllum*, Old World climbing fern, were introduced into Florida where they have become invasive weeds disturbing the ecology and hydrology of wetlands in South Florida and the Everglades. Both invasive plant species are native to the coastal swamps and wetlands of Eastern Australia. Our research is focused on field exploration and evaluation of insects and pathogens of the Australian broad-leaved paperbark tree, and Old World climbing fern, for possible introduction into the United States as biological control agents.

2. How serious is the problem? Why does it matter?

The paperbark tree was introduced into Florida in the United States at the beginning of this century. In the last 30-40 years *M. quinquenervia* has greatly expanded its range in southern Florida where it now infests over 500,000 acres causing extensive environmental and economic damage. Trees, which can grow to 30 m in height, flower and seed prolifically and form dense forests, which displace native plants and animals. Old World climbing fern, *L. microphyllum* has recently been listed as a Federal noxious weed. The vine climbs high into trees and over shrubs, smothering whole plant communities. Its distribution is rapidly expanding in central and south Florida including pine plantations, citrus groves, bald cypress swamps, wet prairies, saw-grass marshes and Everglade tree islands. It now covers more than 130,000 acres.

3. How does it relate to the National Program(s) and National Program Components to which it has been assigned?

This research is closely aligned with the USDA Strategic Plan for Invasive and Noxious Weeds, and the ARS Weed Science Program (80 percent). Research on invasive wetland and aquatic weeds of the Florida Everglades also contributes to the Water Quality and Water Management National Program (20 percent).

4. What is your most significant accomplishment this past year?

Accomplishment - a) A second biological control agent of *Lygodium microphyllum*, was discovered, evaluated, and shipped to the USA this year. We have continued to implement our multi-lab team strategy to fast-track the discovery, testing and evaluation of agents. Impact: Quarantine screening of the first agent has been completed and a petition for release is

underway. A second biological control agent for the damaging weed *L. microphyllum* is now in culture at ARS quarantine facilities in Gainesville. The rapid response (2 agents shipped in 2 years) shows ARS's serious commitment to biological control and its ability to respond quickly to threatening invasive species.

Accomplishment - b) The Melaleuca sawfly, *Lophyrotoma zonalis* has been exported to the U.S., screened, and is pending approval for release. Research in Australia has demonstrated that the agent poses no significant toxicological risk to cattle. Impact: This agent will likely be approved for release based on this data. The biological control program will be able to release agent that has a good potential for success and that can survive in the permanently flooded habitats of the Everglades.

Additional paragraph to support accomplishments:

The noxious aquatic weed *Salvinia molesta* has recently invaded Texas and Louisiana. Biological control programs conducted by CSIRO in Australia have been very successful using the weevil, *Cyrtobagous salviniae* originally imported from S. America. *Cyrtobagous salviniae* from Australia were compared with weevils believed to be *C. salviniae* from Florida using molecular sequencing. Sequencing of the nuclear rRNA D2 gene from both populations revealed considerable differences indicative of separate species. This information may also explain why *C. salviniae* from Florida failed to establish on *S. molesta* in Texas. Based on this information ABCL staff collected, reared and shipped over 500 *C. salviniae* weevils from Australia to the ARS-Invasive Plant Research Lab, Ft. Lauderdale, FL for screening and field release.

5. Describe the major accomplishments over the life of the project, including their predicted or actual impact

Over 450 insect species, which feed on *M. quinquenervia*, have been collected by USDA-ARS Australian Biological Control Laboratory in Queensland and northern New South Wales. The melaleuca weevil, *Oxyops vitiosa*, released in late 1997, is well established in Florida and spreading rapidly from all release sites. An ARS area-wide management program is underway to extend the success of this agent to all infested areas. Quarantine studies have been completed for on three additional insects, a defoliating sawfly, *Lophyrotoma zonalis*; the sap-sucking psyllid, *Boreioglycaspis melaleucae*; the melaleuca bud-gall fly, *Fergusonina* sp. and all are likely to be permitted for release. Release of the psyllid is expected in November 2001. The tube-dwelling moth, *Poliopaschia lithochlora* will be shipped to stateside cooperators in January 2002. Laboratory and field studies in Australia are now concentrating on three new potential agents; the flower feeding moth complex, *Holocola* spp., the melaleuca borer (Cerambycidae), the leaf defoliating caterpillar, *Careades plana*, and the gall-forming cecidomyiid midge, *Lophodiplosis indentata*.

The research program in Australia is linked directly with ARS research in Ft. Lauderdale, Florida. Jointly, we are discovering and evaluating biological control agents for *M. quinquenervia*, *Lygodium microphyllum* and other invasive noxious weeds of the Florida Everglades. Without long term sustainable biological control based management of *Melaleuca*

and *Lygodium*, large parts of the Everglades and South Florida would be permanently degraded causing tremendous loss of native species, with less available water to agriculture and the cities. Our research supports the South Florida ecosystem restoration and is expected to maintain sustainable agricultural production and improve environmental quality.

6. What do you expect to accomplish, year by year, over the next 3 years?

Accomplishment: Exploration for additional biological control agents (insects and pathogens) of *M. quinquenervia* will continue into previously unexplored areas of Australia. Field surveys will be directed into habitats that more closely match the permanently flooded sites of the Florida Everglades. Exploration will also begin the cooler more temperate areas in southern range of *M. quinquenervia* in New South Wales. Rearing methods for agents with complex or lengthy developmental cycles (ie. borers, flower feeders), that also have excellent potential as agents, will be developed.

Impact/Outcome: New agents with highly destructive biologies will be able to be reared, therefore allowing for host specificity screening/utilization in program. Additionally, new agents with a better climatic match for northern Florida and the southeastern U.S. will be discovered. This research may result in additional agents, which are adapted to meet the specific conditions found in the U.S. Slowing the spread of this noxious weed and reducing its competitiveness with the native vegetation is the expected outcome.

Accomplishment: The biological control program directed against *Lygodium microphyllum*, Old World climbing fern should be near completion of the initial exploration phase for natural enemies. Several herbivores should be in the final stages of host range testing. We will attempt to complete all, or most the host range testing for the phytophagous mite, *Floracarus* sp. in Australia since it is so difficult to rear and contain a small mite in a quarantine. The overseas labs provide the unique ability to complete testing in the native environment where quarantine issues are not relevant.

Impact/Outcome: Reducing the regenerative potential of this rapidly growing vine by introducing highly specific leaf-defoliating herbivores is expected. Exploration for agents with different modes of attack, ie. stem borers, which could potentially kill *L. microphyllum* plants, will continue.

7. What science and/or technologies have been transferred and to whom? When is the science and/or technology likely to become available to the end user? What are the constraints, if known, to the adoption and durability of the technology products?

Biological control agents of *M. quinquenervia*, highly specific herbivorous insects, have been identified through field exploration and transferred to ARS scientists in Florida for field application. Additional agents are being identified for both *M. quinquenervia* and *L. microphyllum*. A leaf-feeding weevil, *Oxyops vitiosa* has been field released and is now the key agent in an area-wide weed suppression program in Florida. Quarantine studies have been completed on four additional insects, a defoliating sawfly, *Lophyrotoma zonalis*; the sap-sucking

psyllid, *Boreioglycaspis melaleucae*; the melaleuca bud-gall fly, *Fergusonina* sp. and all are likely to be permitted for release. Release of the psyllid is expected in November 2001. Eight species of insects and one mite have been identified for biological control of *L. microphyllum*. Host range testing of a leaf defoliating pyralid moth, *Cataglyphis camptozonale*, has been completed and a petition for release will be submitted in 2002. A second agent, *Neomusotima conspurcatalis* has been shipped to ARS collaborators in Florida for final quarantine testing.

A solid conceptual framework for determining the physiological host range of a biological control agent allows us to accurately predict the field host range of the introduced insect or pathogen. However, as with any biological control agent, predicting the efficacy in its introduced range is difficult. The adoption of a biological control strategy for management of *M. quinquenervia* and *L. microphyllum* is highly likely if the agents prove to be effective in the field. Revegetation efforts will be required to replace the exotic weeds with native plant species. The durability of the technology is excellent given that the agents reproduce indefinitely in their new environment.

8. List of most important publications and presentations to non-scientific organizations.

Goolsby, J. A., Purcell, M. F., & Wright, T. 2001. Biocontrol Down Under. Wildland Weeds v. 4 (3) p.17-20.

Purcell, M. F. Impact of Australian native plants as weeds in the USA. Totally Wild, Channel 9 Network. June 2001.

Goolsby, J. A. (ed) 2000 Annual Report of Research at the Australian Biological Control Laboratory. South Florida Water Management District. West Palm Beach, Florida. Jan 2001.

Wood, M. & Garcia, J. 2001. Beating the Australia Bush for Melaleuca's Enemies Agricultural Research v. 49 (4) p. 27-28.

Wood, M. & Suszkiw, J. 2001. Appalachian Scholars AID ARS Scientists in Australia and France. Agricultural Research v. 49 (4) p. 28.

9. Scientific Publications:

Goolsby, J.A., Burwell, C.J., Makinson, J. and Driver, F. 2001. Investigation of the Biology of Hymenoptera Associated with *Fergusonina* sp. (Diptera: Fergusoninidae), a Gall Fly of *Melaleuca quinquenervia*, Integrating Molecular Techniques. Journal of Hymenoptera Research v. 2 (2) p. 172-2000.

Goolsby, J.A., Tipping, P.A., & Center, T.E. 2000. Evidence of a New *Cyrtobagous* Species (Coleoptera: Curculionidae) on *Salvinia Minima* Baker in Florida. Southwestern Entomologist. V. 25 (4) p. 299-301.

Kirk, A.A., Lacey, L.A., and Goolsby J.A. 2001. Vector-Insect-Plant Interactions, Harris, K.F.,

Smith, O.P., Duffus, J.D. editors, Academic Press, New York, NY. Classical Biological Control of *Bemisia* and Successful Integration of Management Strategies in the United States. P. 309-324.

Pemberton, R.W., Goolsby J.A, &. Wright, T. 2001. Biological Control of Weeds in the Eastern US. R.G. Van Driesche, Editor. Biological Control of *Lygodium microphyllum*. (in press).

Goolsby, J.A., Wright, A.D. Purcell, M.F., Zonneveld, R., Makinson, J.M . 2001. Biological Control of *Melaleuca quinquenervia*, *Lygodium microphyllum* and other weeds of Australian and Southeast Asian origin. Available from: <http://www.ars-grin.gov/ars/SoAtlantic/aust/>